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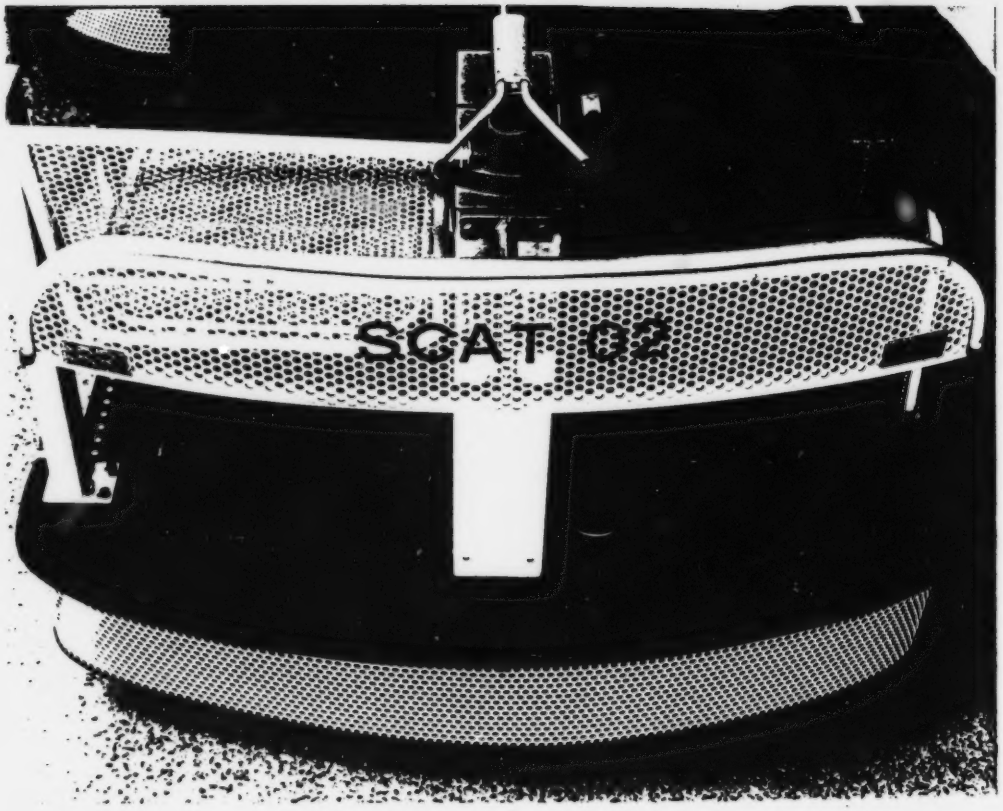

MODULAR TRANSFER PLATFORM (SCAT 02) OUTDOOR MODEL PROTOTYPE DEVELOPMENT AND FIELD TESTS

PREPARED FOR
TRANSPORTATION DEVELOPMENT CENTRE
TRANSPORT CANADA

BY
RUTENBERG DESIGN INC.

JULY 1986

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TRANSPORT CANADA

BY

U. RUTENBERG

M. BARBER

RUTENBERG DESIGN INC.

July 1986

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The contents of this report reflect the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre.

Un sommaire en français de ce rapport est inclus avant la Table des matières.

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17. Abstract

This report describes the design, building and testing of two transfer vehicle platform prototypes designed for use at large exhibitions, fairs, and parks, where long distances create mobility problems for elderly and disabled persons. Named SCAT 02 (Small Carrier for Alternative Transport), the system consists of compact low-level platforms, one of which is driven by three 12V batteries and operated by a person sitting beside the tiller column. The other, a non-motorized platform, can be linked to the motorized unit. Four passengers are seated on two-seat rows, one on each end of the platform, facing each other. The curved ends of the platform keep the turning radius small.

All platforms have a ramp for wheelchair access on one side, a folding seat and a handrail. For protection against sunshine and rain, each platform is equipped with a canopy.

The test program consisted of a comprehensive set of test scenarios to determine technical performance, ride qualities, handling, and boarding and deboarding. Seven passengers were accommodated along with the driver on the motor unit with one trailer. Improvements in the area of braking and steering are necessary. For the driver, head and knee clearances have to be increased; for the wheelchair passenger, the space between him/her and the driver's seat needs to be extended to facilitate boarding and manoeuvering of the wheelchair.

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17. Résumé

Ce rapport décrit les travaux d'étude, de réalisation et d'essai de deux prototypes de véhicule à plate-forme pour le transport des personnes âgées et des handicapés à l'intérieur des grandes surfaces: expositions, parcs, etc. Surnommé VITE 02 (pour Véhicule Intégré de Transport Electrique), ce véhicule se compose de deux plates-formes mobiles surbaissées. L'une d'elles, équipée d'un moteur alimenté par 3 batteries 12V, est dirigée par un conducteur assis près de la colonne de direction; l'autre lui est attelée. Quatre passagers, assis deux par deux sur deux banquettes se faisant face, peuvent y être transportés. Le rayon de braquage du véhicule est très court grâce aux extrémités courbes des plates-formes. Celles-ci sont équipées d'une rampe mobile pour faciliter l'accès aux personnes en fauteuil roulant, d'un abattant formant siège de banquette et d'une barrière garde-corps. Un toit en toile est également prévu contre les intempéries. Un batterie d'essais a eu lieu pour vérifier le comportement mécanique et la tenue de route du véhicule et pour déceler tout problème dans sa conduite et durant les opérations de montée et de descente. Les résultats ont mis en évidence la forte traction du véhicule, même dans les rampes à 12 p. 100. Sept personnes, y compris le conducteur, y avaient pris place. Il a été constaté que le freinage et la direction gagneraient à être améliorés, que le dégagement pour la tête et les genoux du conducteur était insuffisant, de même que l'espace entre la personne en fauteuil roulant et le siège du conducteur.

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SUMMARY

In 1984, a prototype modular transfer vehicle for indoor use was developed for the Transportation Development Centre (TDC) and field tested at Dorval Airport with mobility impaired passengers. Two motorized and two non-motorized platforms were built and are now undergoing further performance tests at different Canadian airports.

The design, building, and preliminary testing of this vehicle are described in TP 3796 E "Travellers with Special Needs, Modular Transfer Platform Design Concept" and TP 5818 E "Modular Transfer Platform - Development and Evaluation."

Examination of these prototypes by TDC engineers indicated that with certain modifications, (i) larger tires for rough terrain and (ii) a larger motor capable of speeds of 6-8mph (10-13 km/h), the model would be suitable as a test vehicle for TDC's Moli battery and for a transport system for mobility impaired visitors at EXPO '86 in Vancouver.

A contract was awarded to RUTENBERG DESIGN INC. in October 1984, to design and build the outdoor model of the transfer vehicle referred to as SCAT 02 (Small Carrier for Alternative Transport).

This design consists of a motorized and a non-motorized platform. Both have a low road clearance level of 6½" (16.5 cm) for easy access on left and right sides. All platforms are equipped with a canopy as protection against direct sunshine and rain. The width of the platform is increased to 44" (117 cm) to allow two adult passengers to sit comfortably side by side. The non-motorized platform can carry four adult-sized passengers or six children. Each platform has a folding ramp to allow access by a wheelchair. The ramp is vertically stored when not in use.

The motorized platform has a rear-driven axle with a differential and a 2 HP/36V electric motor with three 12V batteries. The tires on the drive axle are 12" (30 cm) in diameter and 4" (10 cm) wide; all the other tires are 8" (20 cm) in diameter. The braking system consists of a disc brake directly mounted to the gearbox. Maximum speed is 12-14 mph (20-23 km/h), unloaded; and 6-8 mph (10-13 kh/h), fully loaded.

The platform is linked by a crosswise linkage system which, with the curvature at the ends of the platforms, keeps the turning radius very small.

Testing of SCAT 02 was conducted at the Regional Depot of Transport Canada in Dorval, Quebec, and included a technical performance evaluation as well as driver and user tests.

Technical evaluation consisted of load tests on horizontal and inclined surfaces of up to 12%, e.g. gravel, pavement, grass, with the single motor unit and with the trailer.

Driver testing included human factor evaluations such as handling of the vehicle, operation of hand and foot controls, and assisting in boarding and deboarding of impaired passengers.

A few disabled passengers (wheelchair users, blind, elderly) performed preliminary tests for accessibility, boarding/deboarding, and ride comfort.

The test results in all areas were very favourable with only minor improvements recommended in the areas of braking, steering, and adjustments for greater head and knee clearances for the driver. For wheelchair users, additional space between these passengers and the driver's seat was also recommended.

SOMMAIRE

En 1984, le prototype d'un véhicule modulaire de transport intérieur avait été étudié et réalisé pour le compte du Centre de développement des transports (CDT) et essayé à l'aéroport de Dorval, ayant à bord des passagers à mobilité réduite. Quatre plates-formes ont été réalisées, deux motrices et deux remorques à atteler à celles-ci. Elles subissent actuellement des essais plus poussés dans divers aéroports canadiens.

L'étude, la réalisation et les essais préliminaires de ce véhicule ont fait l'object des rapports TP 3796 E intitulé "Travellers with Special Needs, Modular Transfer Plateform Design Concept" et TP 5818 E entitulé "Modular Transfer Platform - Development and Evaluation".

Ayant attentivement examiné ces prototypes, les ingénieurs du CDT ont trouvé que, certaines modifications aidant (par exemple: des pneus plus larges et un moteur plus puissant pouvant entraîner le véhicule à 6 ou 8 mi/h (10 à13 km/h), le véhicule en question pourrait servir de banc d'essai à la batterie Mo-Li financée par le CDT et également pour le transport des personnes à mobilité réduite à Expo 86 qui doit se tenir à Vancouver.

En octobre 1984, un contrat a été signé avec la firme RUTENBERG DESIGN INC. en vue de réalisation d'un modèle destiné au transport extérieur, le VITE 02 (pour Véhicule Intégré de Transport Electrique). Il comporte deux plates-formes, dont l'une est motrice; les deux sont surbaissées (la garde au sol

étant de 6½ pouces ou 16½ cm) afin de faciliter l'accès des deux côtés. Un toit en toile est prévu afin de protéger contre le soleil et les intempéries. La largeur des plates-formes a été portée à 44 pouces (117 cm) pour que deux passagers puissent s'asseoir confortablement côte à côte. La plate-forme attelée peut transporter quatre adultes ou six enfants. Les deux sont équipées d'une rampe mobile facilitant l'accès aux personnes en fauteuil roulant, la rampe étant relevée à la verticale par la suite.

La plate-forme motrice comporte un essieu moteur à l'arrière et un différentiel, entraînés par un moteur électrique 2 Hp alimenté par 3 batteries 12 V. Les roues de l'essieu moteur ont des pneus de 12 pouces (30 cm) de diamètre et de 4 pouces (10 cm) de largeur, les autres pneus ayant 8 pouces (20 cm) de diamètre. Un frein à disque monté directement sur la boîte d'engrenages assure le freinage du véhicule.

La vitesse maximale est de 12-14 mi/h (20-23 km/h) à vide et de 6 à 8 mi/h (10 à 13 km/h) à pleine charge. Le rayon de braquage du véhicule complet est très court grâce à un attelage à bielles croisées de conception originale et à des extrémités de plate-forme courbes.

Les essais sur le VITE 02 ont eu lieu dans les installations régionales de Transports Canada à Dorval; essais de comportement mécanique ainsi que essais routiers avec passagers à bord. La traction du véhicule chargé a été vérifiée sur des plans horizontaux et inclinés jusqu'à 12 p. 100 de pente et sur divers types de surface: gravier, chaussée revêtue et gazon, la plate-

forme motrice circulant tour à tour seule et attelée. Les essais routiers ont comporté des essais ergonomiques sur la précision de la direction, les commandes à la main et au pied et les opérations de montée et de descente des passagers à mobilité réduite. En outre, des essais préliminaires ont été faits avec la collaboration de personnes handicapées: en fauteuil roulant, aveugles ou âgées, afin de vérifier certains aspects du véhicule tels que l'accessibilité. la tenue de route et les problèmes durant la montée et la descente.

En résumé, tous les résultats des essais ont été favorables à l'exception du freinage, de la direction et des dégagements pour la tête et des genoux du conducteur, qui ont besoin d'une légère mise au point. Pour les personnes en fauteuil roulant, un écartement plus grand par rapport au siège du conducteur a été recommandé.

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1.0 INTRODUCTION

A prototype Modular Transfer Vehicle SCAT 01 for indoor use in transportation terminals was developed for the Transportation Development Centre (TDC) as a result of an unsolicited proposal in 1981. Two motorized and two non-motorized platforms were built and are now undergoing field tests at different Canadian airports.

The examination of these protoypes by TDC engineers indicated that a version with larger tires, a stronger motor, and an increased speed of approximately 10-13 km/h (6-8 mph) would be suitable as a test vehicle for TDC's Moli battery and for a transport system for mobility impaired visitors at EXPO '86 in Vancouver.

The following project addresses the design, building, and testing of SCAT 02.

1.1 Objectives

The overall objective of the Transportation Development Centre is to foster the development of technology in the form of equipment, systems, and procedures which make it possible for elderly and handicapped persons to have access to and to use transportation services in Canada.

1.1.1 The sub-objective is to eliminate travel barriers for the elderly and handicapped in all modes and to develop alternative designs and procedures facilitating travel for these persons.

1.1.2 The project objective is to develop and field test a prototype of SCAT 02, a two-unit modular transfer platform with an outdoor capability and a speed of approximately 10-13 km/h (6-8 mph).

2.0 REQUIREMENTS

The objectives were to design and build a two-unit vehicle system as a prototype based on possible use at the Canadian Pavillion during EXPO 86 with the following characteristics:

- a low platform which is motorized and of low speed.
- a low platform which is trailing and can be linked to the motorized unit, to transport mobility impaired people.

Seat Capacity

- one sitting driver off-center to allow for maximum seat capacity of passengers
- 3 adult passenger capacity on motorized platform
- 4 adult passenger capacity on trailing platform
- one space for wheelchair passenger on motorized platform taking the place of one seat only with ramp on one side of platform
- 2 wheelchairs on trailer, taking not more than two seats
- all seats to be foldable

2.1 Technical requirements

- to be driven on off-road pedestrian pathways
- motor unit driven by rechargable batteries at approx. 10-15 km/h (6-8 mph)
- progressive speed control 0 - full speed forward
- progressive speed control 0 - 5 km/h (3 mph) in reverse
- tire size and profile to negotiate gravel surface with small crevices
- to negotiate incline of 10% fully loaded
- braking distance of 3 m (10'0") on level surface with full load

- to lock brake at incline with full load
- to accelerate from braking position on incline
- to brake descending 10% incline to full stop
- audio signal for warning while driving on congested pathways
- turning radius of approx. 4.5 m - 5.5 m (15' - 18') with trailer (as required by Canadian Pavillion on West Promenade)
- electrical system to be rechargeable at a rate of approx. 8 hours over night
- charger receptacle on motor unit
- protective bumper around each platform
- red reflectors to the rear on each vehicle
- steering on two front wheels

2.2 Driver requirements

- to be trained for the specific task of assisting in boarding and deboarding of mobility impaired passengers
- to drive motor unit from seated position
- to steer with right hand
- operate controls by hand: forward, reverse, key switch, horn
- foot controled: speed and braking
- driver visibility over walking crowd and to all sides must be guaranteed
- front safeguard for driver's protection
- manual operation of connecting and disconnecting motor unit and trailer
- easy handling of ramps, seats and wheelchair tie-downs
- safeguarded charging operation

2.3 Passenger requirements

To provide transportation for walking distances with inclines of approx. 10% for and within the vicinity of the Canadian Pavillion for mobility impaired visitors. Distances can be between 0.2 - 1 km (800' - 2800').

The user target group consists of:

- users of manual wheelchairs
- people with canes
- elderly
- pregnant women
- mother with baby

Their requirements are:

- a low step platform with non-slip surface
- visible color contrast on platform edge
- handsupport when boarding and deboarding
- driver assisting boarding and deboarding
- trained driver for careful driving
- protection against sun and rain, when seated
- ramp for boarding wheelchairs
- securement for wheelchair during travel and on ascents and descents
- safety before speed
- individual seats on platform with ergonomic consideration for short time travel and emphasis on getting in and out easily
- one armrest per seat for support
- smooth acceleration and decelleration
- unobstructed visibility for all passengers

- storage space for handbags, crutches, canes
- appearance of vehicle to be modern and not "handicapped" associated
- foot protection so as not to accidentally step under wheels

3.0 DESIGN APPROACH

First, design consideration was given to size, power train, and use of the vehicle outdoors.

A revision of the indoor model revealed that a number of conditions had changed due to different parameters and expectations. In an indoor environment, the size of the vehicle was determined by doors and elevators, and its tire size by tile floors. The outdoor model would have to transport more passengers per ride, have bigger tires, a stronger motor, and a higher speed. Certain protection for outdoor use against weather conditions and a much sturdier framework were necessary. It was decided to change the one wheel front drive to a more powerful rear axle drive.

It was imperative to keep the low platform level to allow easy access on and off the vehicle from both sides by people with reduced physical stamina and balance. The width of the vehicle, 48" (1.22 m), was determined by two adult passengers sitting side by side or one adult and two youngsters, or one wheelchair and one adult. The length of 72" (1.83 m) was determined by two seated passengers facing each other.

This led to the design of a split seat arrangement with a center section where one seat and the center will be folded to make room for a wheelchair of approximately 27" (69 cm) wide. The ramp is 34" (86 cm) wide and allows comfortable maneuvering with space to spare on each side.

Boarding of the wheelchair is by an assistant/driver who steps on the vehicle's platform with the wheelchair tipped back so as to place the user's weight over the rear axle of the wheelchair. Pulling the wheelchair backwards up the ramp with the large tires first is the easiest for the assistant and puts very little strain on his back. The wheelchair will then be wheeled back against a folded seat and secured against moving by a cord and lock which are attached to the platform

The driver's place is left of the steering control column which is situated at the front center of the motorized unit. The driver sits on an adjustable seat with the right hand controlling the tiller and the left hand supported on a front facia.

Both of the driver's feet are placed on the elevated front part which houses the steering mechanism and the wheels.

Speed and braking are controlled by two foot pedals the same way as a car, an action most people are used to. An on-off switch and control lights are mounted on a panel on the steering column, easily visible for the driver and slightly inclined should rain ever reach the panel.

The steering lever moves within a protective frame radiating the lever action area. Through a vertical steering rod, which is supported by bearing points, the two front wheels are steered over a horizontal rod linkage system. The elevated rear portion of the vehicle houses three 12V batteries, five solenoids, a coil, and the power train. The electrical system is based on a 36V DC deep cycle set-up. Speed control is achieved by a solenoid-coil system, which burns excessive power on the coils. There are four progressive forward speeds on a 36V circuit and one reverse speed on a 12V circuit with a reversible 36V DC motor. The power train consists of a fixed axle with a gearbox, differential, and motor mounted on four rubber mounts to the main frame.

The two rear wheels of 12" (30 cm) in diameter and 4" (10 cm) wide are driven by a two horsepower electric motor on 36V DC over a differential and a gearbox with a reduction of 2.5:1. Mounted directly on the gearbox is a disc brake, which is mechanically operated by the driver's foot pedal.

Mounted on the elevated rear section of the vehicle is a frame for the double seat with three different sections. These fold individually and allow for the greatest number of seating choices.

To provide maximum passenger capacity a seat beside the driver is provided for one adult facing fellow passengers. In order to provide maximum stability for the two persons seated in the front of the motor-unit the front wheels had to be on the extreme sides. A compromise had to be made in the wheel diameter, since this dimension determines the distance between the two stabiliy points.

Provisions are made to have a stretcher on this side, 23" (58 cm) wide by 76" (1.93 m) long, attached to the top of the front and rear seats at a height of approximately 36" (91 cm) over road level.

A canopy is attached to two curved tubes and connected at the rear to the seat frame and at the front to the steering column.

To achieve a small turning radius, a linking mechanism between motor unit and trailer was designed consisting of two cross-linked rods.

Fig. 1 First model and design studies

4.0 BUILDING

Most of the cutting and welding of the metal frame and the tube bending was done at a metal shop in Dorion, Quebec, with all finishing, assembly, and detailing at the workshops of RUTENBERG DESIGN INC.

Despite the higher weight factor, steel was chosen for the main frame and tubes, which allows for easier modifications during the building and prototype stages. A final model could be built in aluminum to save additional weight and prevent corrosion in the outdoor environment, but might add cost for material and labour. The motor, axle, gearbox, differential, and disc brake are supplied by Club Car Importee Ltd. All painted metal parts are baked enamel to provide a durable surface. The floor is a 5/8" plywood bolted to the main frame and covered by a black vinyl floor mat, which is glued to the plywood. The pattern runs perpendicular to the length of the vehicle for easy cleaning.

The steering mechanism was custom built, as well as all linking connections. All parts were tested before and after final assembly.

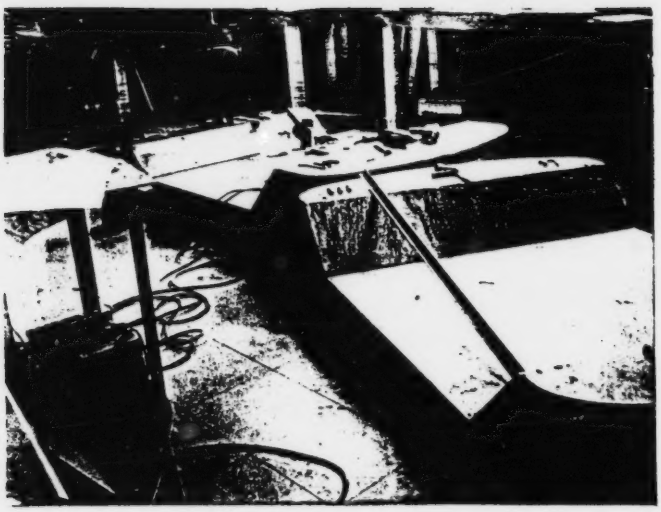


Fig. 2 Main frame building

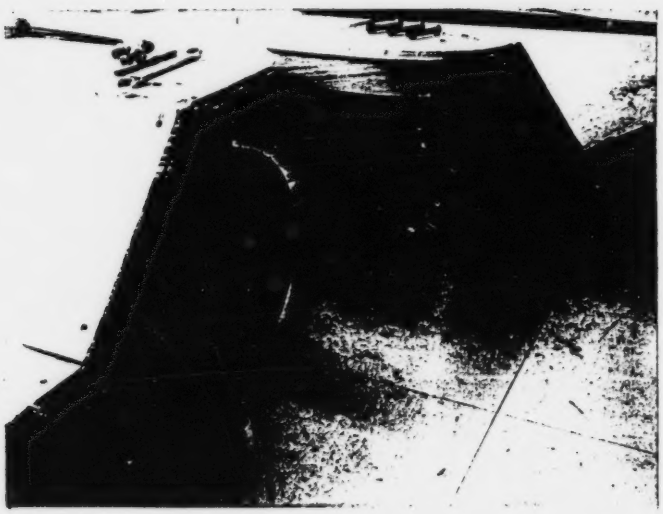


Fig. 3 Curved ends for small turning radius with cross-rod linkage

Fig. 4 Power train and supports on main frame

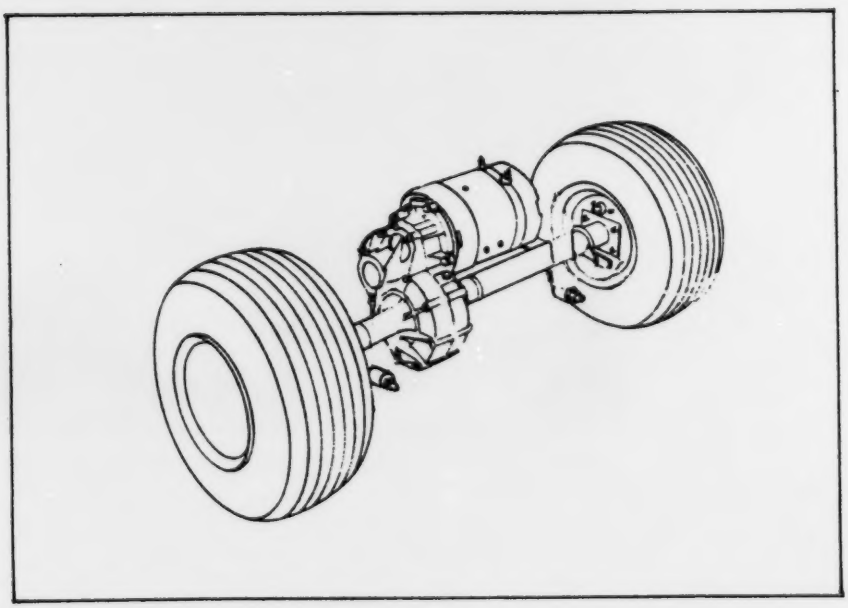


Fig. 5 Complete power train with wheels

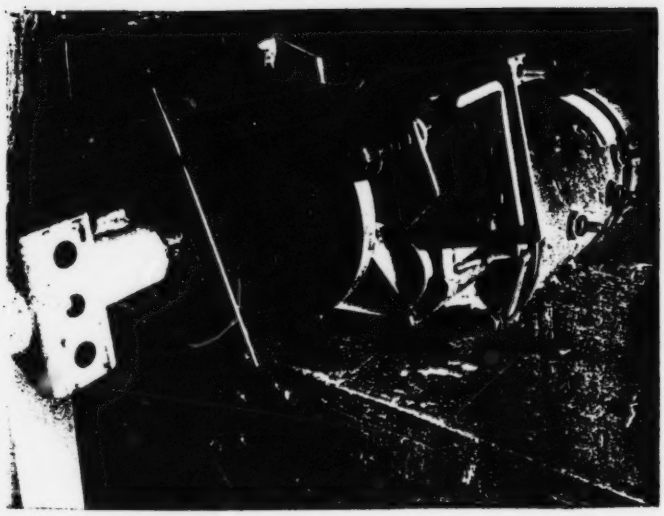


Fig. 6 Disc brake mounted on gearbox

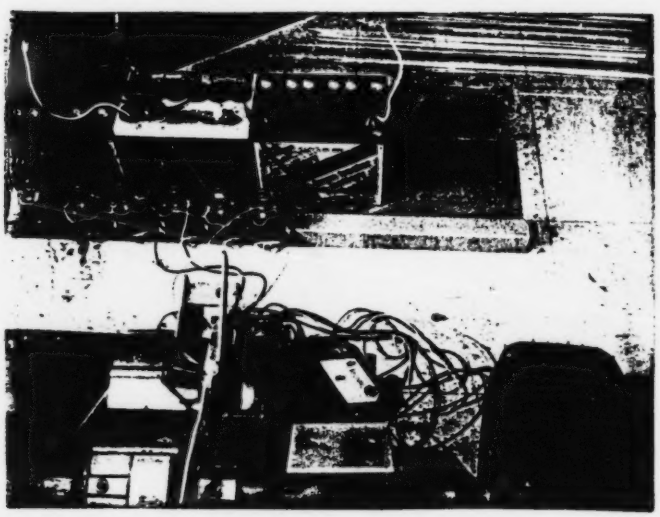
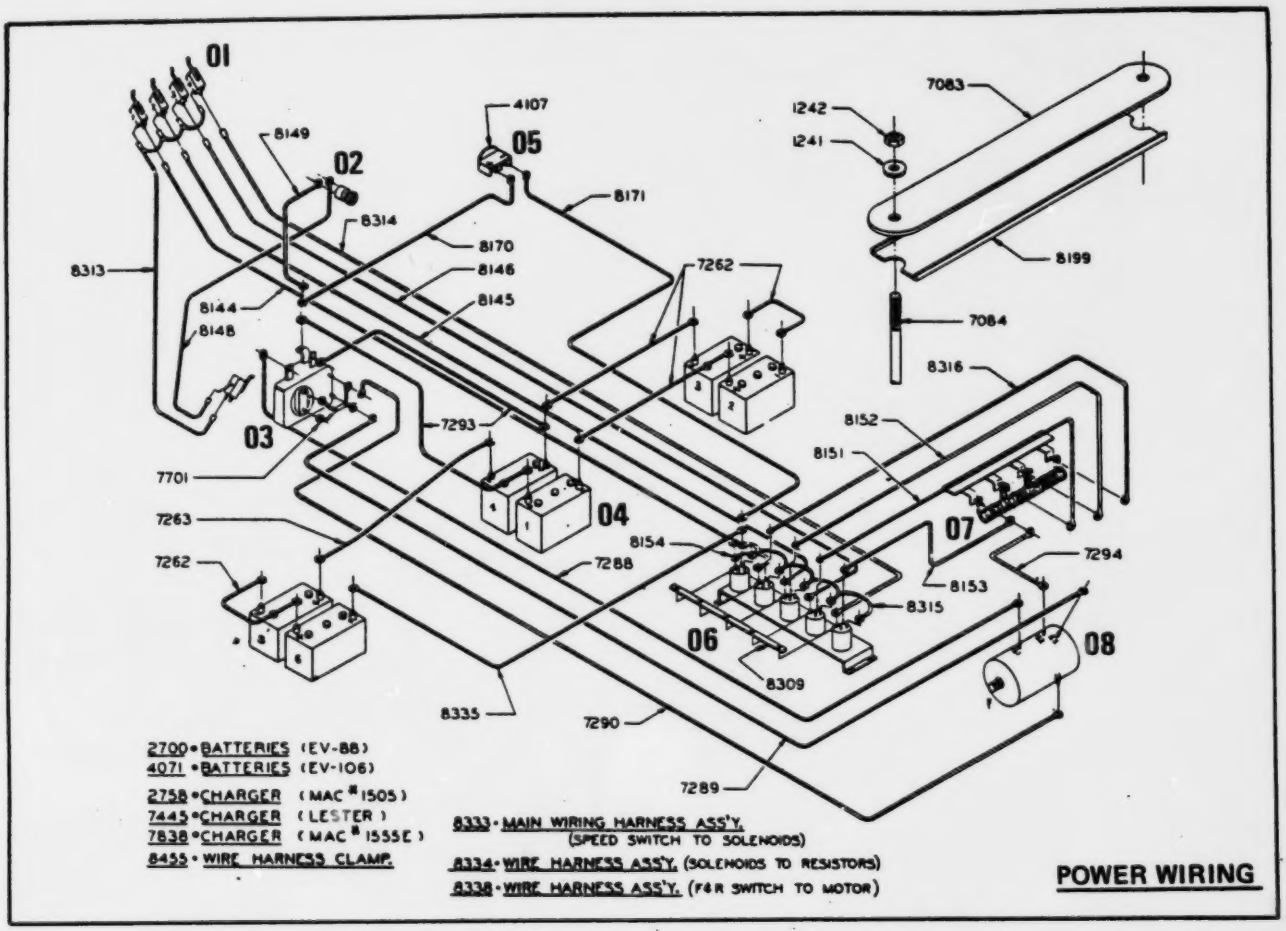


Fig. 7 Electrical components and wire harness

Fig. 8 Power wiring diagram



Part No.	Description
01	4-speed switch
02	Main switch
03	Forward-backward switch
04	Batteries
05	Charger receptacle
06	Selenoids
07	Coil
08	36V motor / 2 HP

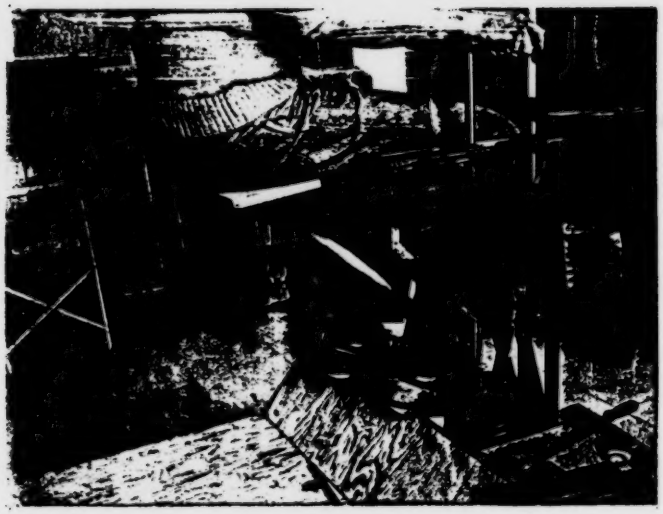
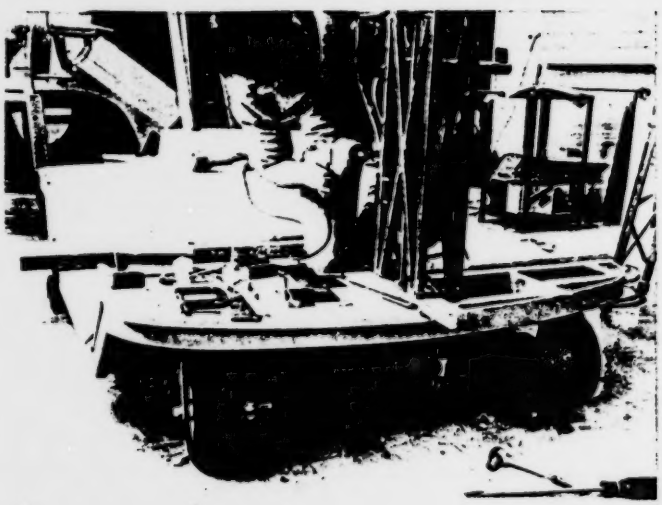


Fig. 9 Testing driver's seat position

Fig. 10 Building steering column support and steering mechanism



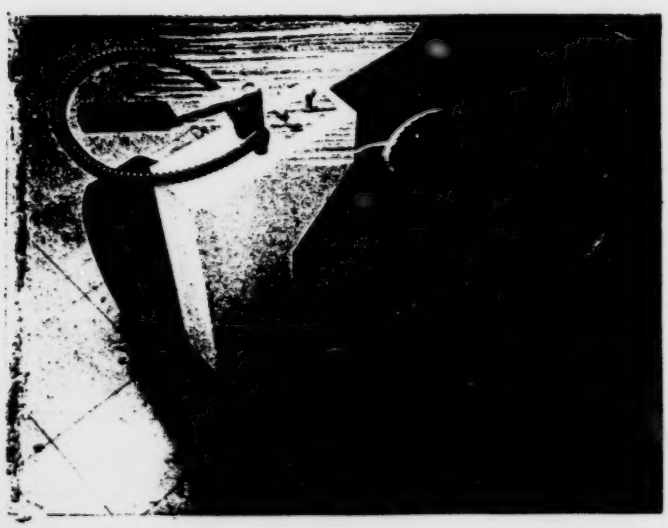


Fig. 11 Steering lever guard, controls and driver's seat

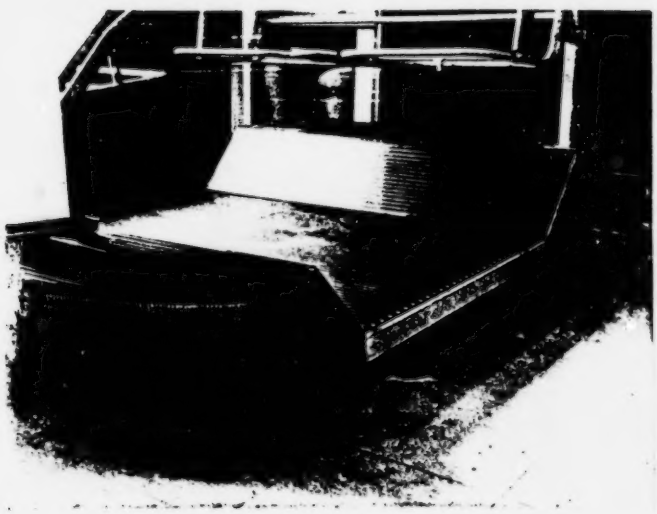
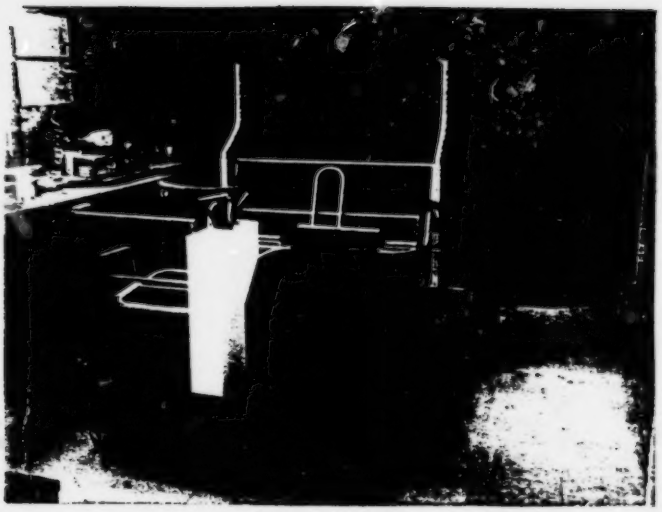


Fig. 12 Protective skirts on front and rear of all SCAT units

Fig. 13 Contrasting color markings on sides of units

Fig. 14 SCAT 02 Motorized unit



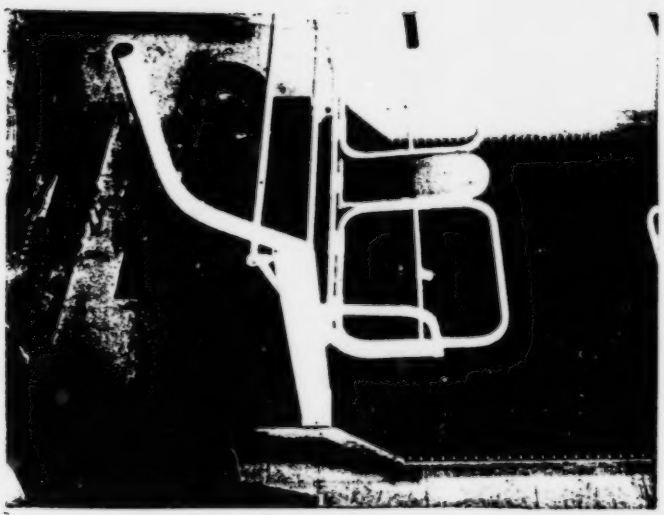


Fig. 15 Rear seat structure of motorized unit

Fig. 16 Front seat structure

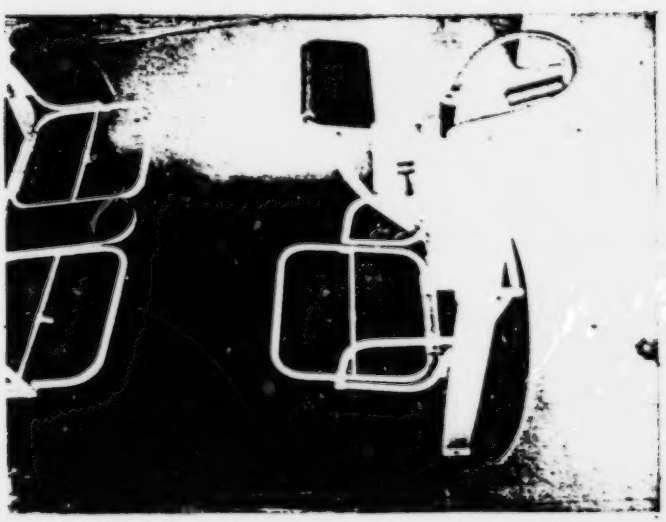
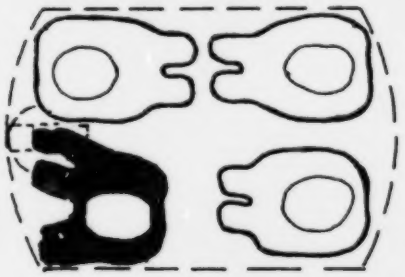


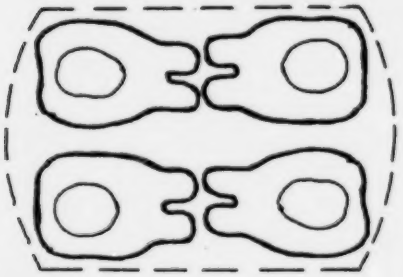
Fig. 17 Seat Lay-outs

MOTORIZED PLATFORM

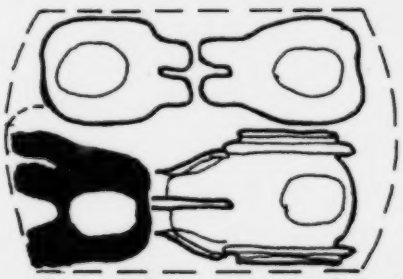


Three adults, one driver

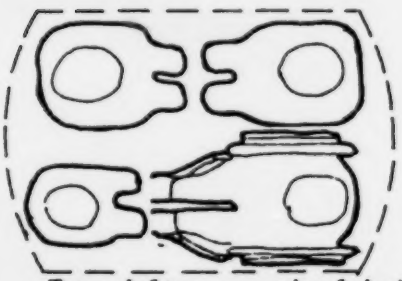
NON-MOTORIZED PLATFORM



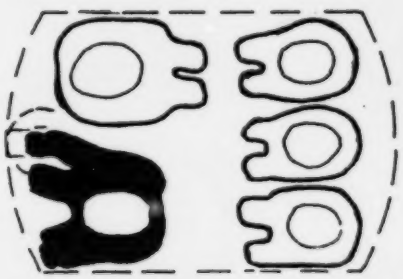
Four adults



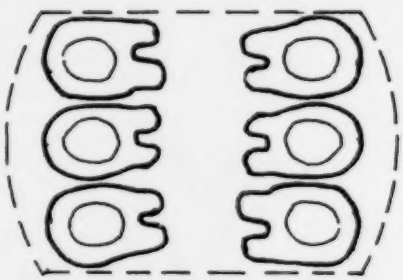
Two adults, one wheelchair, one driver



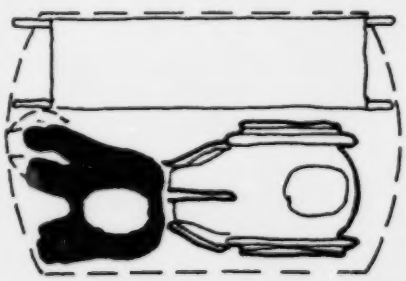
Two adults, one wheelchair, one child



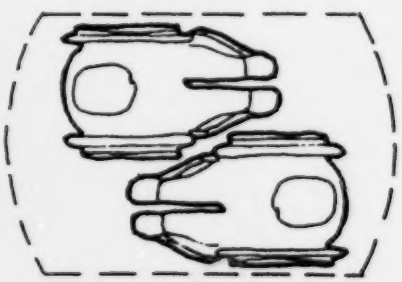
One adult, three children, one driver



Six children



One stretcher, one wheelchair, one driver



Two wheelchairs

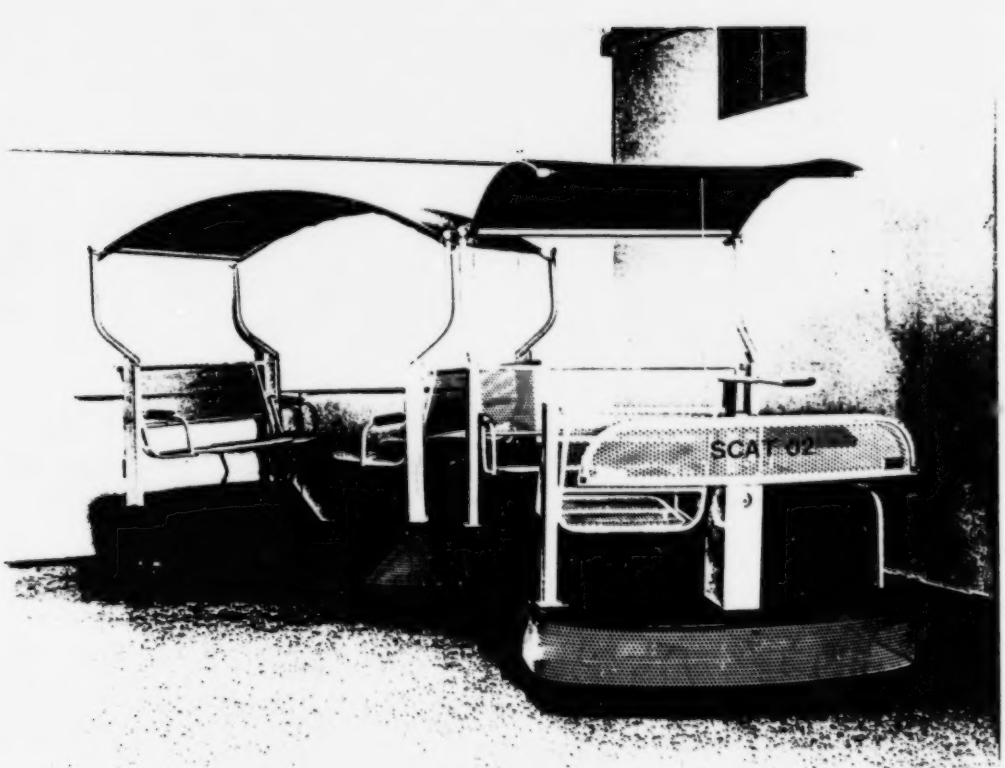


Fig. 18 SCAT 02 Motorized and trailing unit

5.0 TESTING

Testing of SCAT 02 was conducted at the Regional Depot of Transport Canada in Dorval, Quebec. This was an ideal site, since there are large paved surfaces available in different conditions, small hills, curves, and a large ramp with an approximately 12% inclination.

First a technical performance test was conducted to evaluate the capabilities of the vehicle:

The motor unit was driven alone without trailer, and unloaded. The maximum speed was clocked at approx. 18 km/h, the turning radius measured close to 5 m, acceleration easy to control, with steering on the stiff side. The motor unit negotiated without any difficulties a variety of surfaces, such as gravel, pavement, a combination of both, small cracks and pot-holes, grass and cement.

Braking results were satisfactory on horizontal surfaces, but not when descending the 12% ramp. From a standing start on the ramp, the vehicle had to be held by motor power. This was not the fault of the disc brake, but the lack of leverage on the footpedal.

Driving in reverse revealed that the maximum speed (of 1/3 forward) can be easily manipulated. When in reverse at a maximum turning, the steeringwheel's angle was considered too large. This was due to the fact that for this prototype only swivelling casters with a fork were available at the time.

Testing was then done with the trailer connected to the motor unit, both unloaded. Essentially, the same results were obtained, no decrease in speed with the only difference, that at maximum speed the front casters

of the trailer would flutter when unloaded. This action disappeared immediately after one person would sit on the seat over this part of the trailer.

The linking mechanism revealed a great deal of flexibility and adaption to different road levels. The connection was very positive and proved to achieve a smaller radius than convential methods. Longitudinl and tranversal road changes between motor unit and trailer were easily absorbed by the cross-linkage mechanism.

A load testing was conducted with one driver and seven average adults as passengers (three seated on motor unit, four seated on trailer). A decrease in acceleration was noted and on horizontal surfaces the maximum speed was approximately 12 km/h.

Stability and traction of motor unit and trailer were excellent with steering on the heavy side since two people's weight was over the front axle. Different surfaces were negotiated except for wet grass and traction found very good on all of these surfaces with a full load. A 12% ramp was then driven up with a full load without stopping and only a minor decrease in speed noted.

Next, the ramp was driven up halfway, the vehicle brought to a full stop and started again. Without difficulty the motor unit pulled the full load increasing its speed steadily even ascending.

The braking results were not satisfactory for the same reasons as explained before.

The suspension on both units was felt to be very comfortable by all passengers. Although no difficulties were experienced with the tires, it was felt that they are at the limit of their capacity and an increase

in the tire width from 2½ to 3' would increase the safety when in continuous use.

A horn was installed on the motor unit but did not function after a few times of use. Depending on the use of SCAT 02 and the environment, it is working in, two possibilities for a horn are envisaged: one activated only when needed or a continuous interval audio signal that is audible, whenever the vehicle is in operation, and key switch is "on".

In conclusion, the technical part of the testing by RUTENBERG DESIGN INC. by representatives of TDC and the Canadian Pavilion revealed the same results: a valid new concept of transporting a substancial number of mobility impaired passengers on two compact low step platforms.

5.1 User and Driver Testing

For the use of SCAT 02 there are two groups: the driver and the passenger. The passenger group consists of wheelchair users, elderly, pregnant women, mothers with babies, sight impaired and people with general physical stamina problems such as asthma, heart, and breathing conditions.

For the driver's test, a number of representatives from RUTENBERG DESIGN INC., TDC, and the Canadian Pavilion were driving the prototype for the evaluation of the following areas:

1) visibility
2) access and egress to seat
3) steering, forward/reverse
4) hand controls (keyswitch, forward/reverse)
5) foot controls (accelerator, brake)
6) connecting and disconnecting trailer (linking mechanism)
7) assisting in wheelchair boarding
8) head clearance on canopy
9) seating stability and comfort

5.2 Discussion of Test Results

Test results were recorded by observation and direct on-site feed-back.

Visibility was found by all drivers to be excellent to the front and the sides.

Estimation of vehicle size and peripheral reference points for both, the motor unit and the trailer were easy to determine.

Access and egress to and from driver's seat was good, when seat was in

up-right position. The floor finish provided a good non-slip surface to get on and off during driving. The steering tiller provided a variety of positions for the hand, but was found to be on the stiff side. This is mainly due to the fact that suitable wheels for the front could not be obtained from the supplier at this time. Reverse driving speed was found good (1/3 of forward), although the steering tiller had the same stiff feeling. The keyswitch and hornswitch were easily accessible on the main console, with the forward - reverse lever mounted on the inside of the steering housing. This created a problem for some drivers, since it interfered with their knee clearance. There are two controls operated by the driver's right foot: the acceleration pedal next to the steering housing and the brake pedal. Acceleration was considered easy with the right amount of spring (loaded) resistance. The brake pedal consisted of an experimental set-up using the heel. It was felt that because of the cable to disc brake arrangement, not enough pressure was generated by the foot to stop the vehicle within a short distance. Driving up and down an incline it was also felt that a lock-brake is necessary to park on a ramp.

Connecting and disconnecting the trailer is done by releasing two bolts which are secured by the vehicles bumper positions. This operation was considered very easy and efficient.

For the operation of the vehicle, the driver will be trained. A driver will assist the wheelchair user in boarding and deboarding by folding the bench seat and deploying a ramp on one side of the vehicle or trailer. This ramp is secured in the vertical position and then released to the ground. The driver backs the wheelchair against the ramp lip, tilts the

wheelchair in order to place the passengers weight over the axle and pulls him/her up the ramp. The wheelchair will then be swung around with the back to the seat. A tie-down rope and a hook placed on the wheelchair's crossframe will secure the passenger against forward and reverse movements.

Folding the seat, deploying the ramp and pulling the passenger in the wheelchair up the ramp was found easy. The space between the wheelchair passenger and the driver's seat was felt tight by the passenger. Only an increase in the total length of the motor vehicle would allow for a better accommodation.

Space is much better on the trailer without a driver's seat and more room to maneuver. The inclination of the ramp was considered good to pull a passenger up without too much physical strain.

The canopy on the driver's end was found too low for people 6" (1.81 m) tall.

Seating stability was good, drivers usually used their left hand on the front guardrail for support. The knee clearance on this guardrail was found too tight. Bracing the guardrail on the sides to the frame was suggested for more driver protection. The seat requires a rearguard which could also be used by passengers as an additional hand support for mobility impaired passengers to ease in and out of the seat.

5.3 Passenger testing

A wheelchair passenger, a blind person and elderly people were boarding, deboarding, and riding a motor unit and trailer several times.

The low platform edge, highlighting a different material and color contrast, was welcomed by all individuals; the blind person detecting the difference in material finish with a cane. A blind person had to be made aware when boarding due to the low ends of the curved canopy. The storage of aids between seats was also welcomed and the comfort of the seats was good, although a TDC representative felt the lumbar support too low. The armrests were very helpful to stabilize the body during a ride, as well as providing extra support when getting in and out of the seat. An additional feature, such as a rope between the two exterior armrests would probably increase safety while the vehicle is moving. Protection against sun and rain was good and a suggestion was made for additional transparent roll-up blinds on the canopy ends to prevent water running onto the backs of the passengers.

The general riding comfort felt very safe even sitting in a wheelchair, while travelling uphill and downhill. The suspension felt very good on smooth and uneven surfaces.

Duration of trips on such vehicle is estimated to be between 10-25 minutes, therefore, the emphasis was not on speed and long trip comfort, but on the provision of safety and (durable) mobility

The non-slip floor mat was reassuring for elderly with balance problems, although the dark color of the mat should be lightened to prevent showing footmarks. The top speed at approx. 16 km/h was no objection but seems to be too fast if severe braking was to take place. Reduction to approx. 10-12 km/h would probably increase the feeling of security.

The light fresh blue color with the highlighting of certain details in yellow was appreciated since it made no association to the cold chromed tube finishes of typical handicapped products. The design of the vehicle and its general appearance are that of a modern and innovative transportation unit without an undue overemphasis on the handicapped.

6.0 RECOMMENDATIONS

This new design is known as SCAT 02 (Small Carrier for Alternative Transport) for outdoor use.

The following changes are recommended to improve technical and driver's performance as well as passenger requirements.

MOTOR UNIT

- increase clearance between driver's head and canopy structure
- change accelerator pedal position and angle of operation for right foot
- change brake pedal position to arrangement similar to passenger cars
- incorporate parking brake and combine with accelerator pedal
- change steering tiller to steering wheel with 1.5:1 ratio to front wheels
- increase front wheel diameter
- provide fuel gauge for batteries

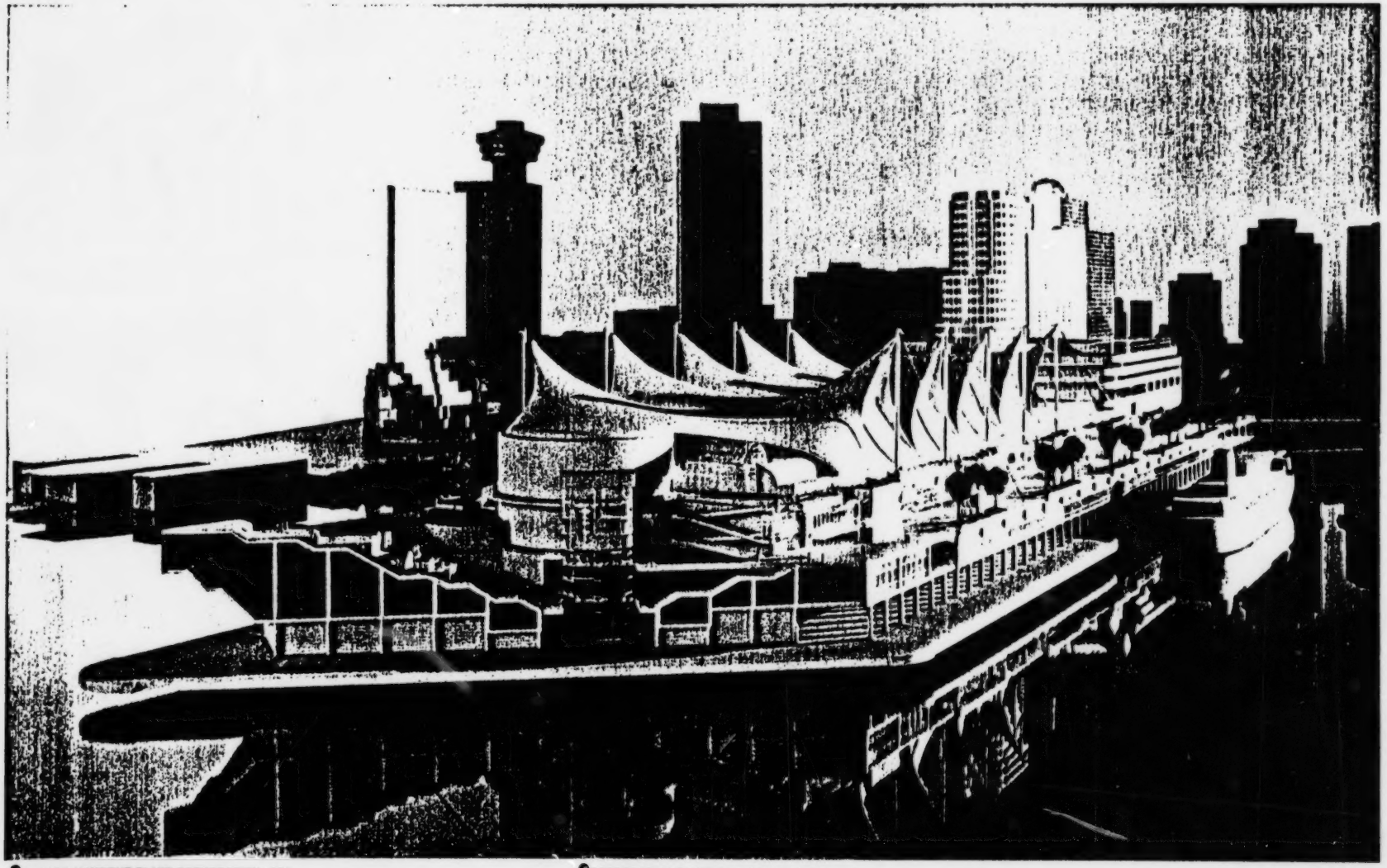
TRAILER UNIT

- increase tire size for all four wheels
- provide tie-downs for wheelchairs

It is suggested these improvements be implemented in a Mark II prototype and tested under service conditions with trained drivers and mobility impaired passengers to determine the vehicle's, as well as driver, passenger, and service performances. The Canadian Harbour Place Corporation has expressed interest in using some Mark II prototypes during EXPO 86. This scenario would be an ideal opportunity to test and evaluate the Mark II version.

TDC has proposed SCAT deployment for CHPC, which is being studied at this point in time.

CANADA PLACE VANCOUVER



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TRADEMARK OF CANADA HARBOUR PLACE CORPORATION

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CANADIAN PAVILION • EXPO 86 • PAVILLON DU CANADA

Canada

Fig.19 Canadian Pavilion, EXPO 86

7.0 FIGURES TESTING

Fig. 21 SCAT 02 with trailer on test grounds

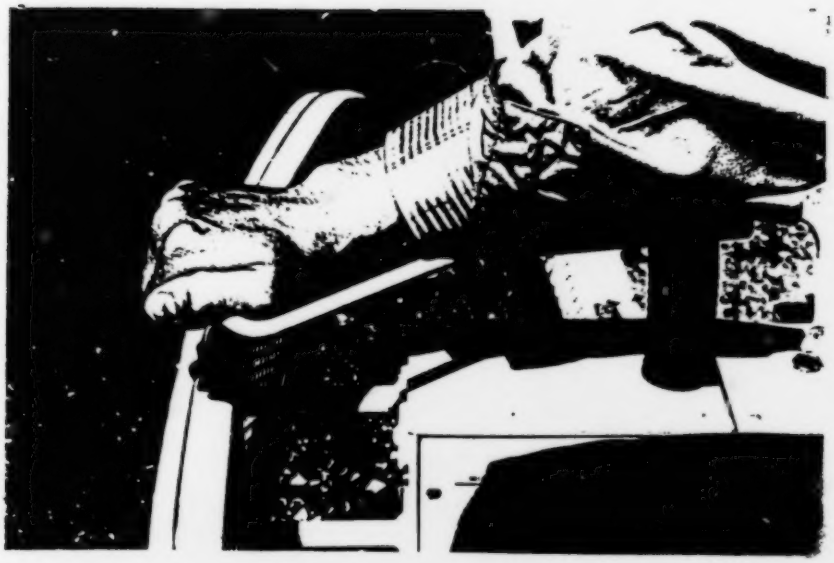


Fig. 22 One hand steering tiller

Fig. 23 Key switch, horn and forward-reverse control

Fig. 24 Head clearance of driver must be increased

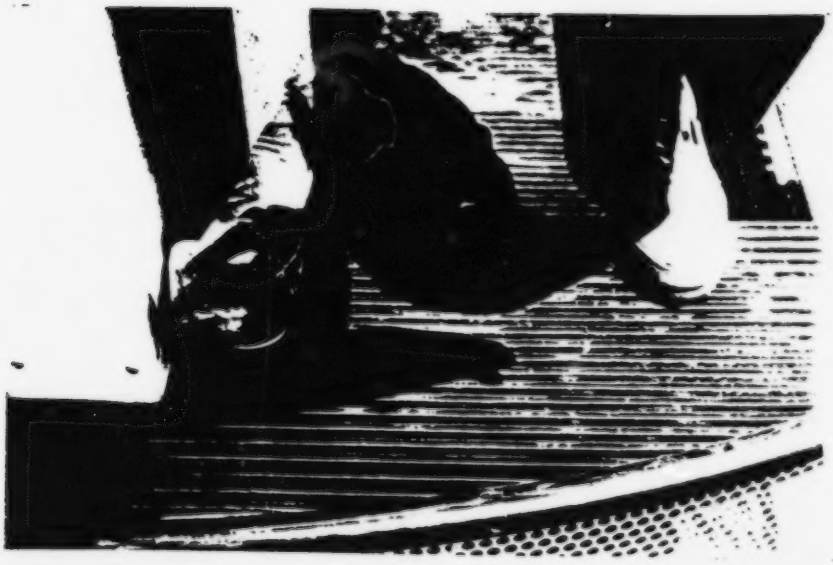


Fig. 25 Speed and brake pedal - brake activated by heel

Fig. 26 Testing turning radius, motorized unit only

Fig. 27 Testing turning radius with trailer

Fig. 21 Testing 10% incline on cement surface

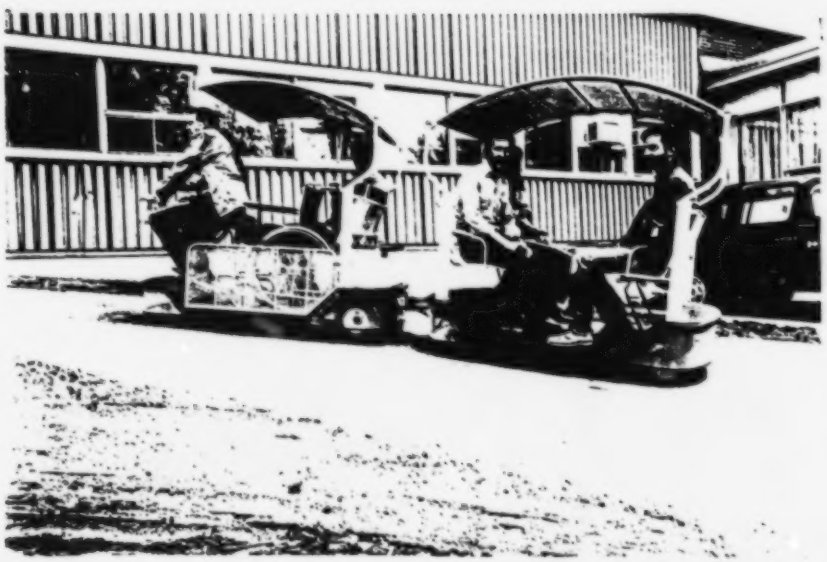


Fig. 22 12% curved ramp with asphalt surface, loaded

Fig. 30 Cross rod linking mechanism

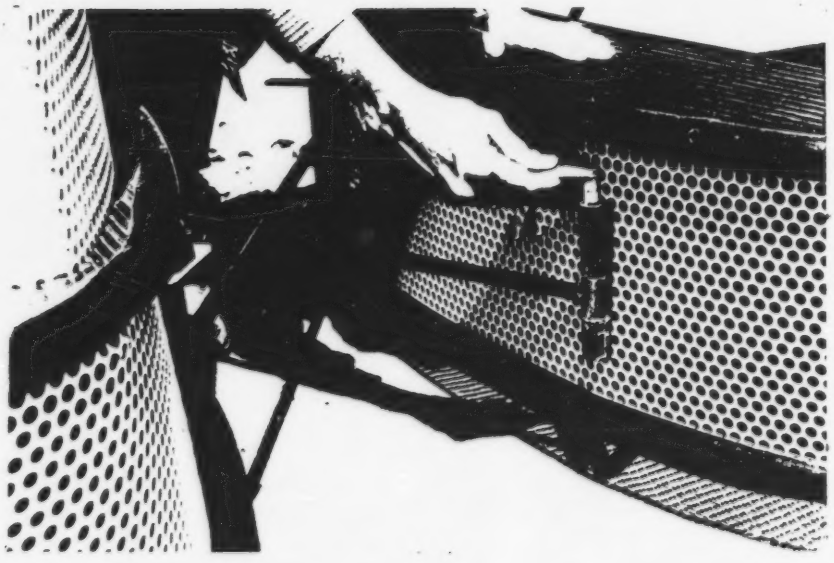


Fig. 31 Manual connecting/disconnecting trailer

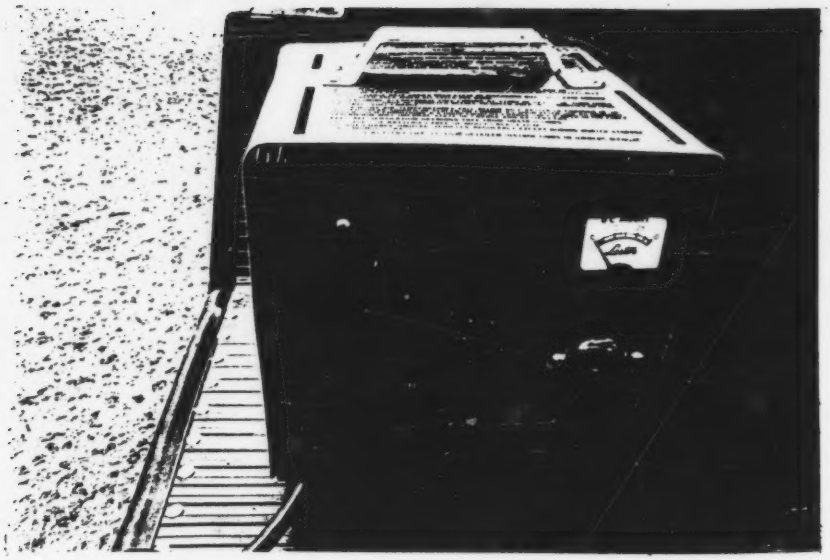


Fig. 32 Heavy duty 36V battery charger

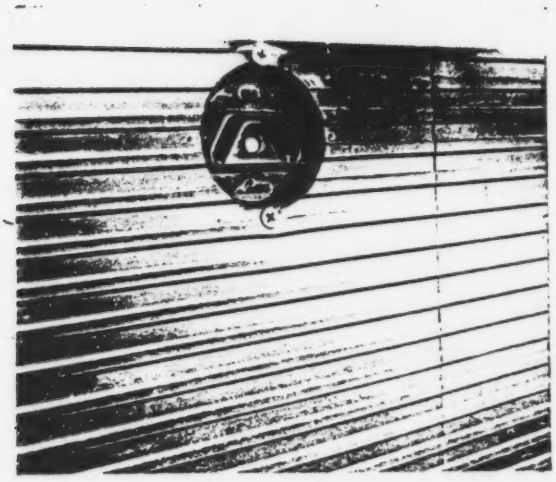


Fig. 33 Charger plug on vehicle

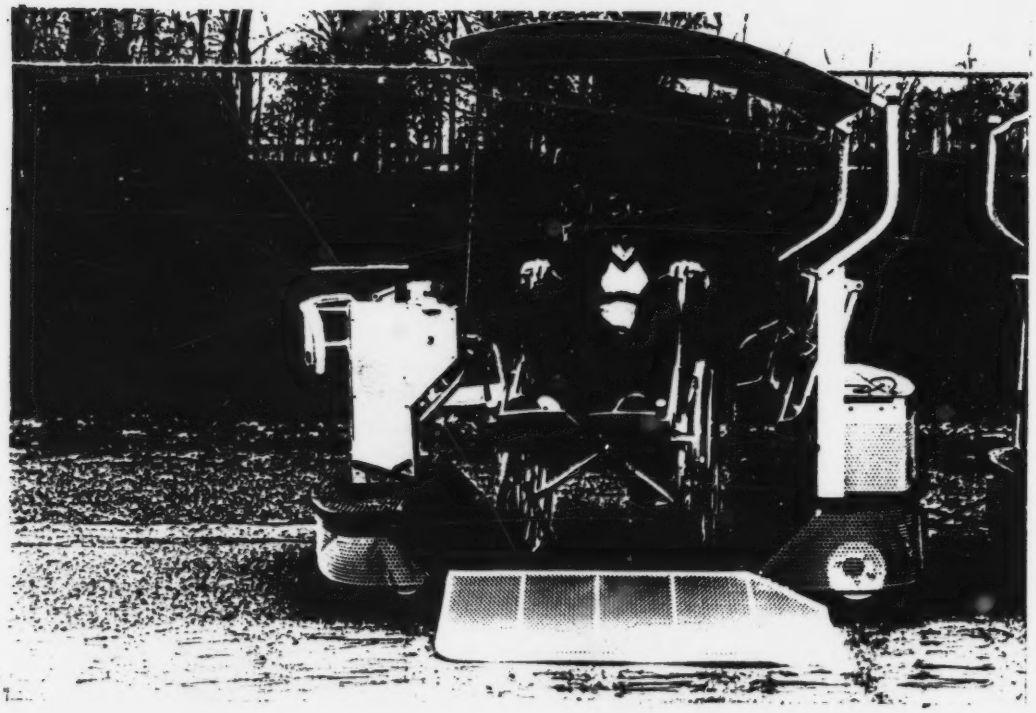


Fig. 34 Boarding wheelchair over deployed ramp

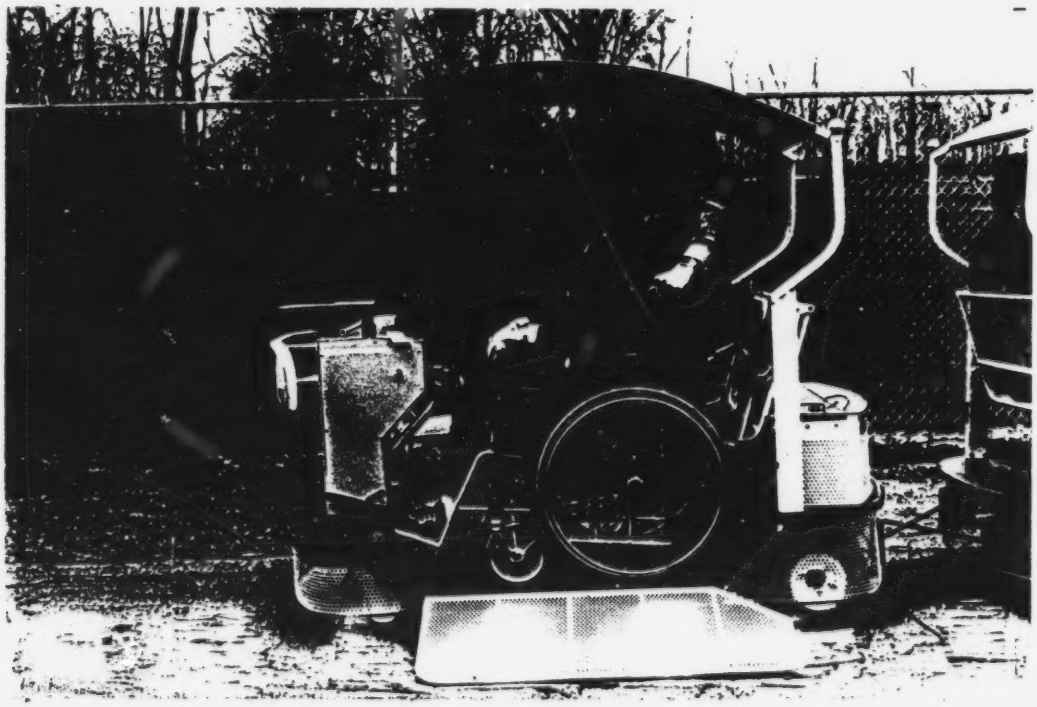


Fig. 35 Positioning of wheelchair on motorized unit

Fig. 26 Kneespace between driver's seat and wheelchair passenger

Fig. 27 Securing wheelchair

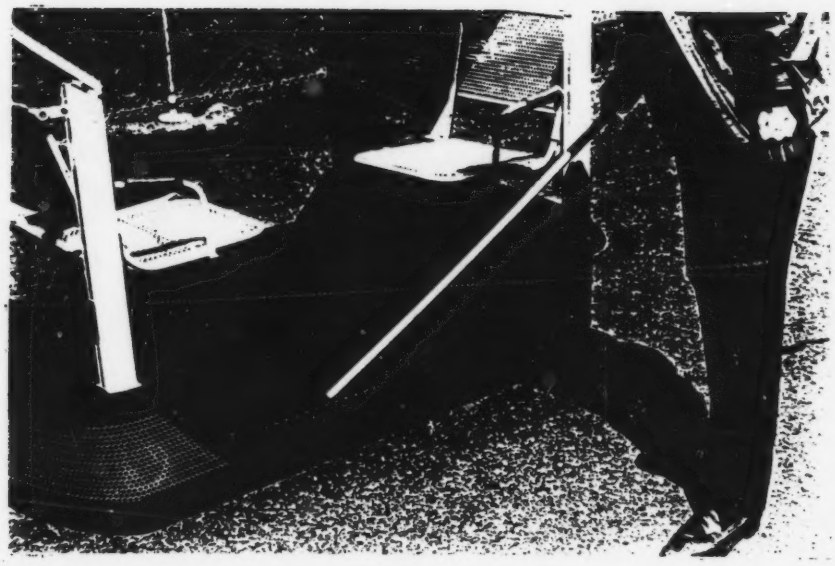


Fig. 33 Sight impaired passenger detecting platform edge

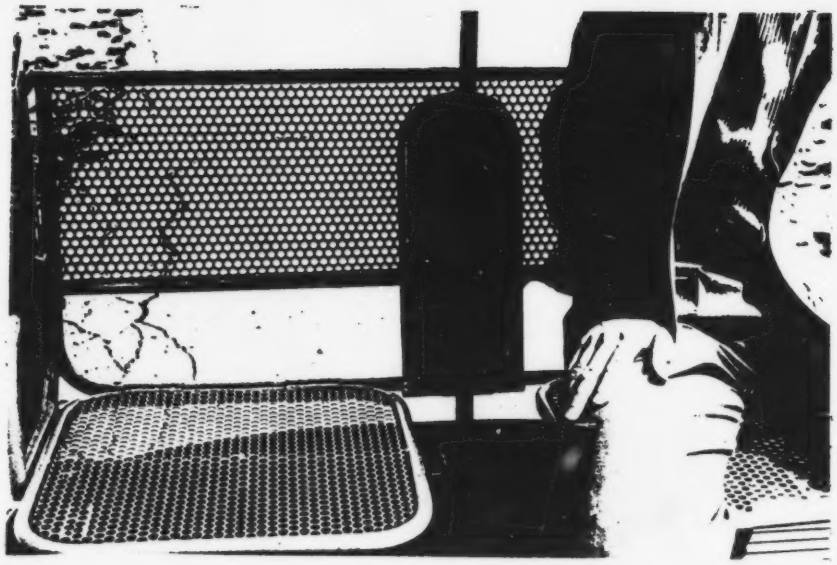


Fig. 34 Storage of aid between two seats

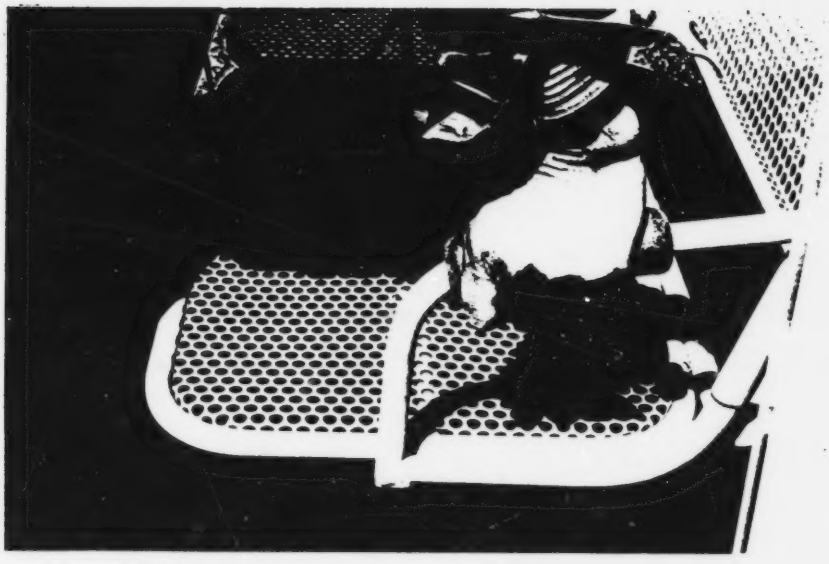
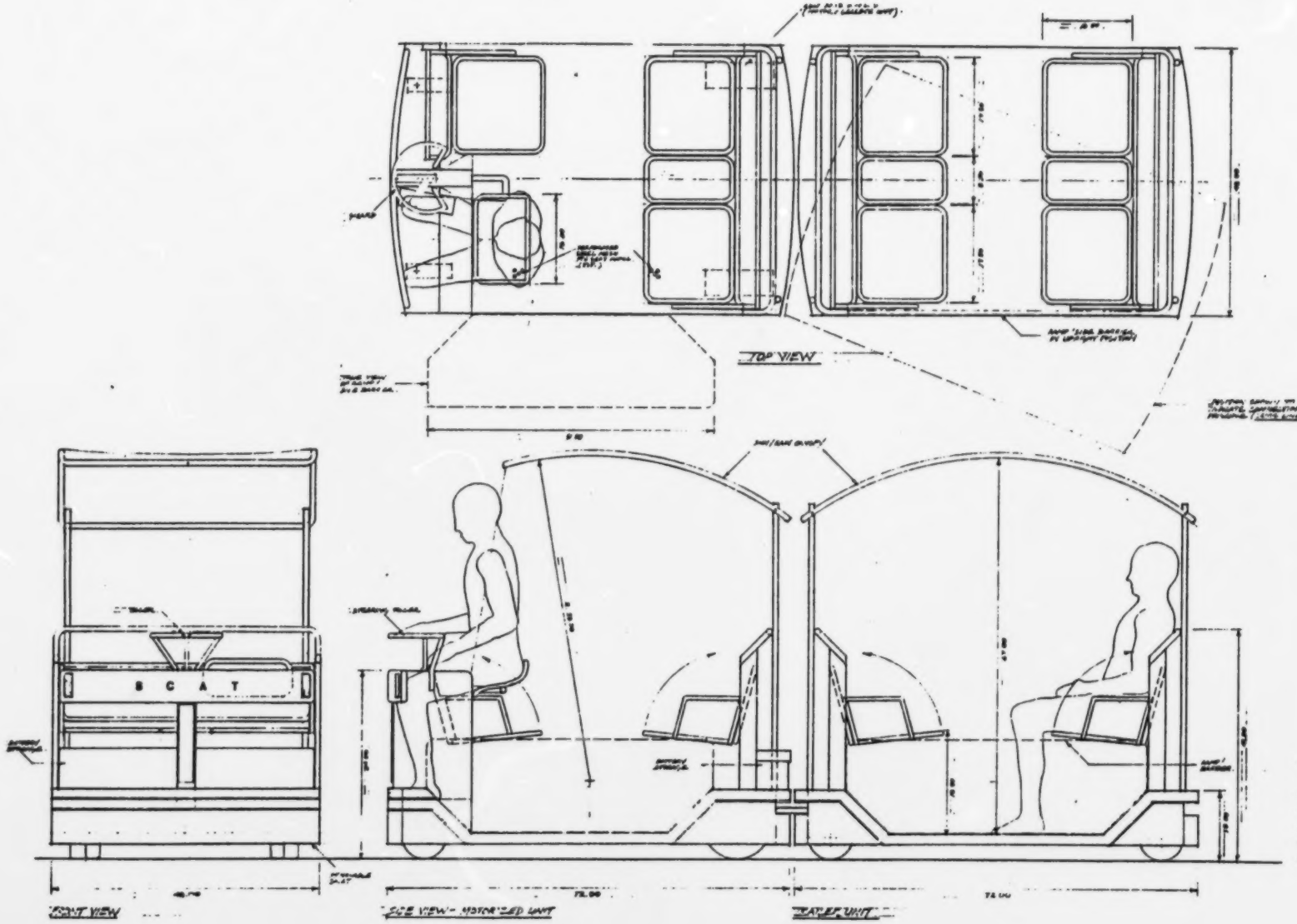


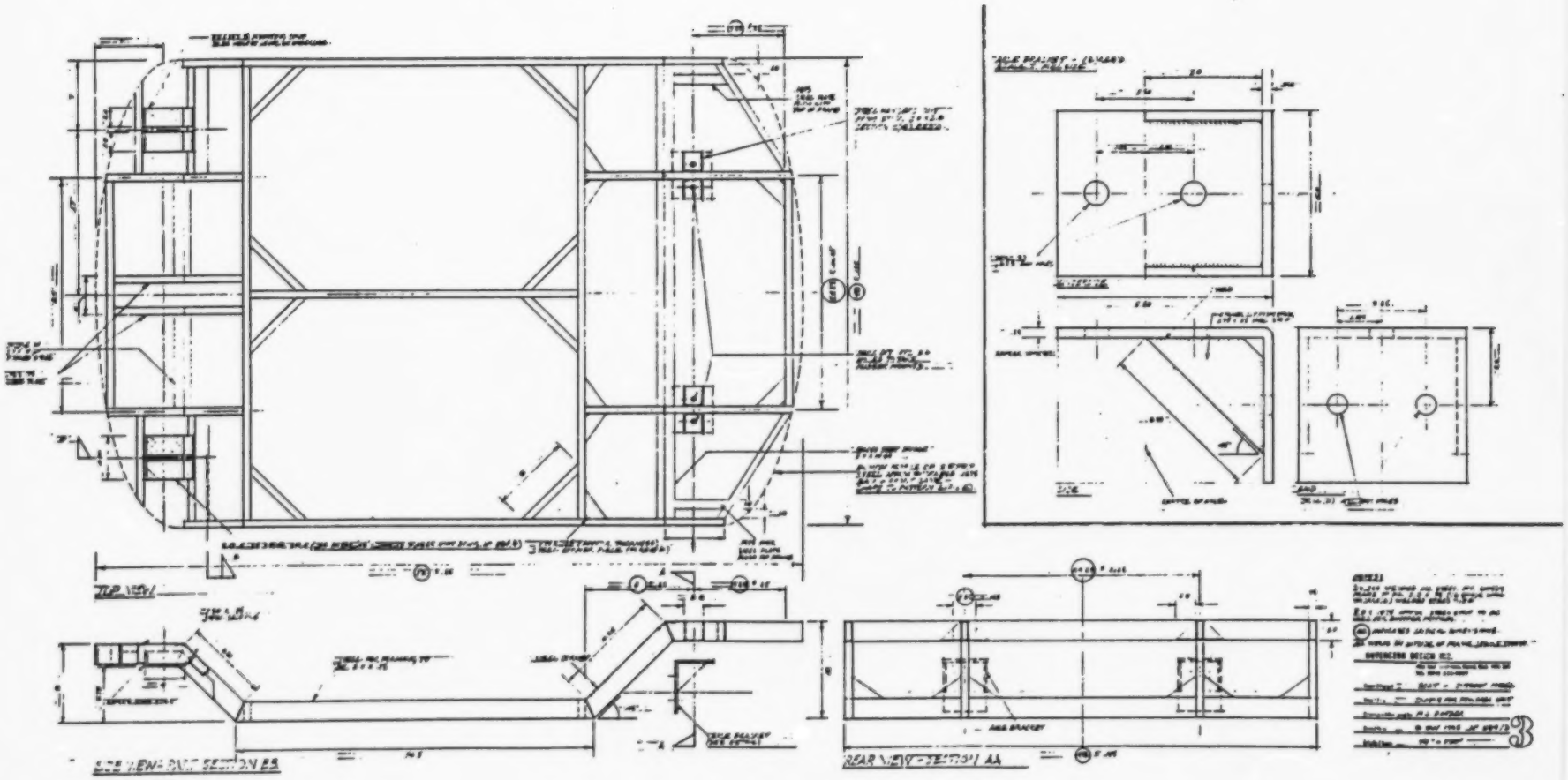
Fig. 40 Armrest as support for boarding and easing out of seat

Fig. 41 High color contrast indication of platform edge for elderly and sight impaired

APPENDIX A PRELIMINARY DRAWINGS


TOP VIEW
SCAT
FRONT VIEW
SIDE VIEW - MOTORIZED UNIT
TRAILER UNIT

A1



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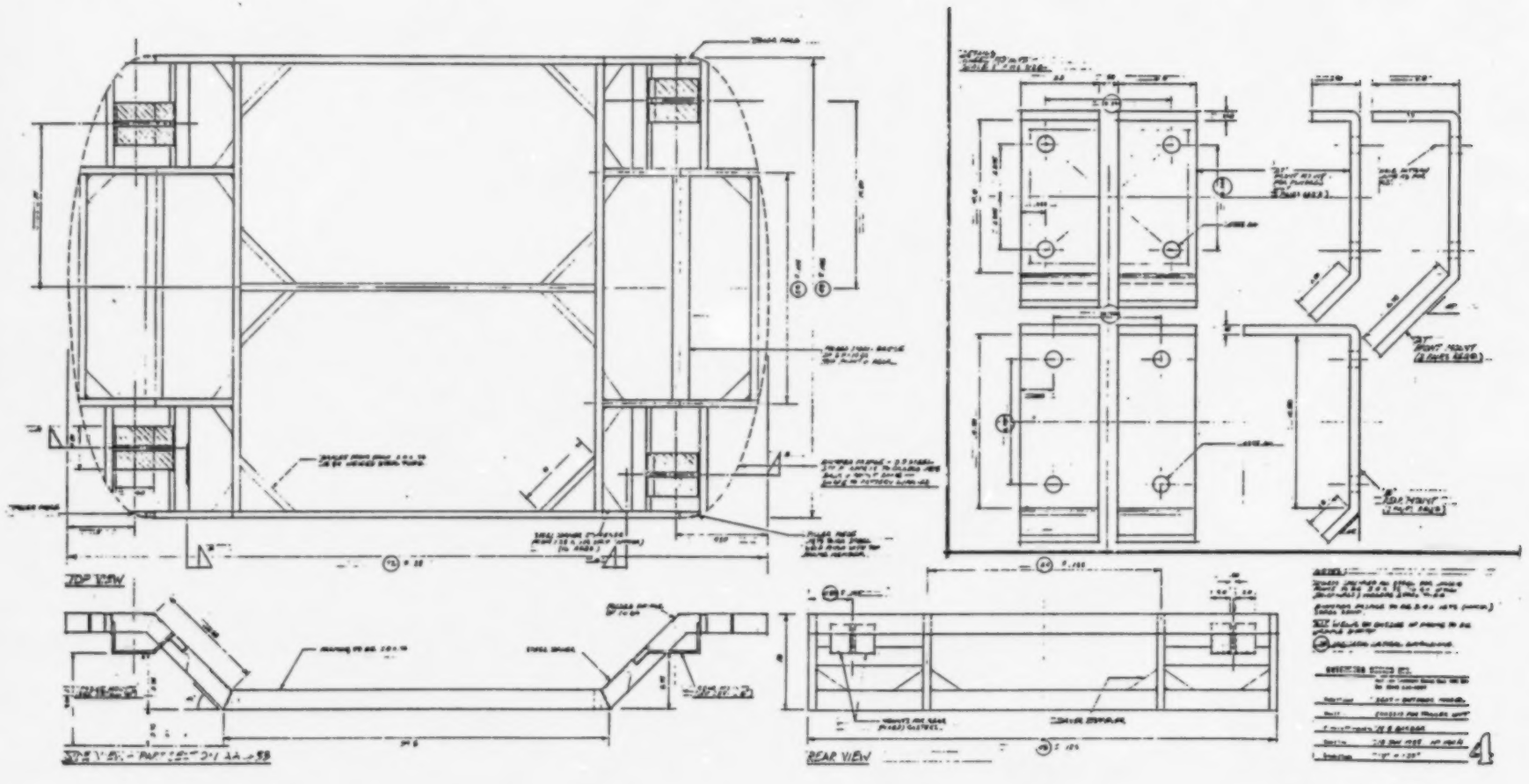

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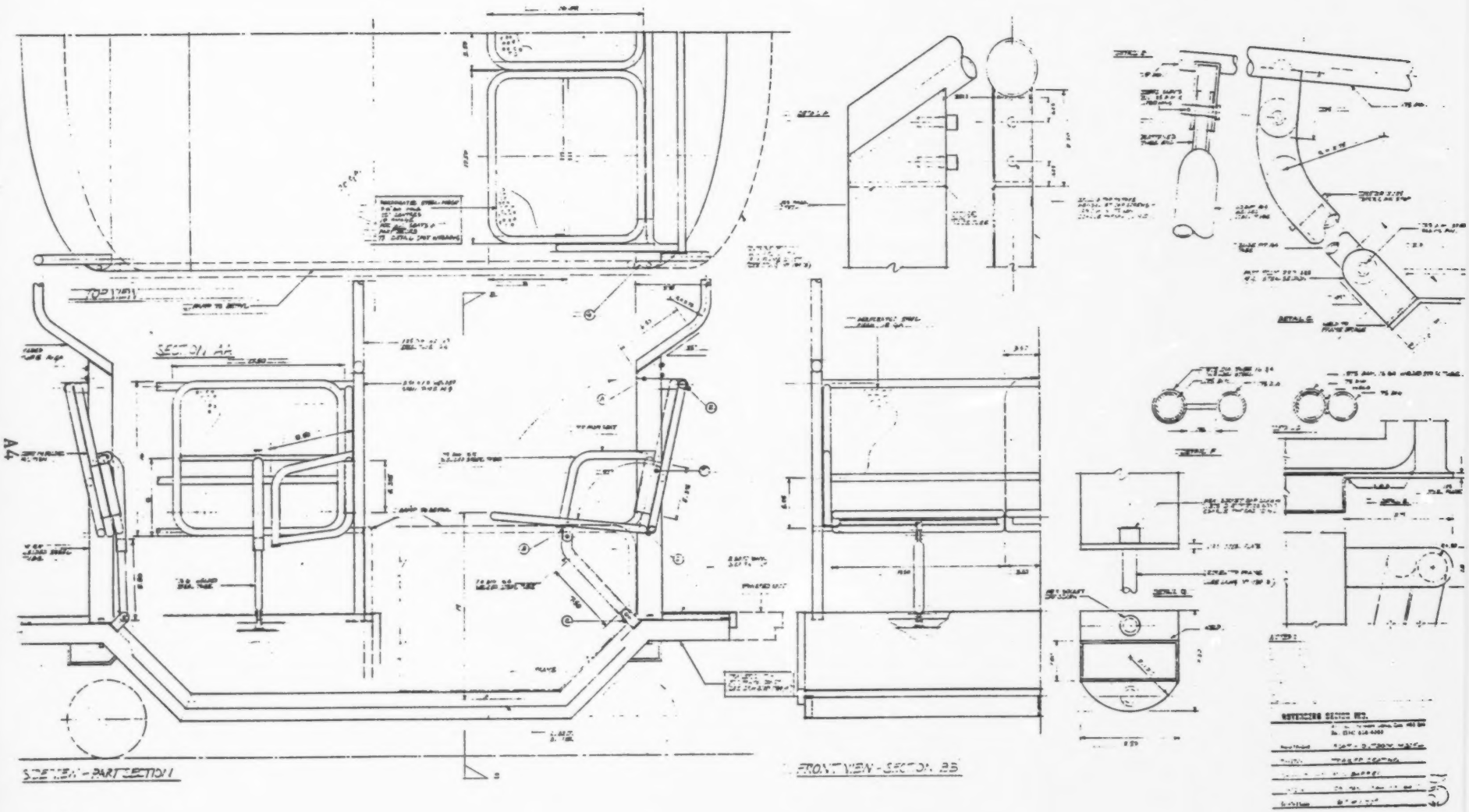
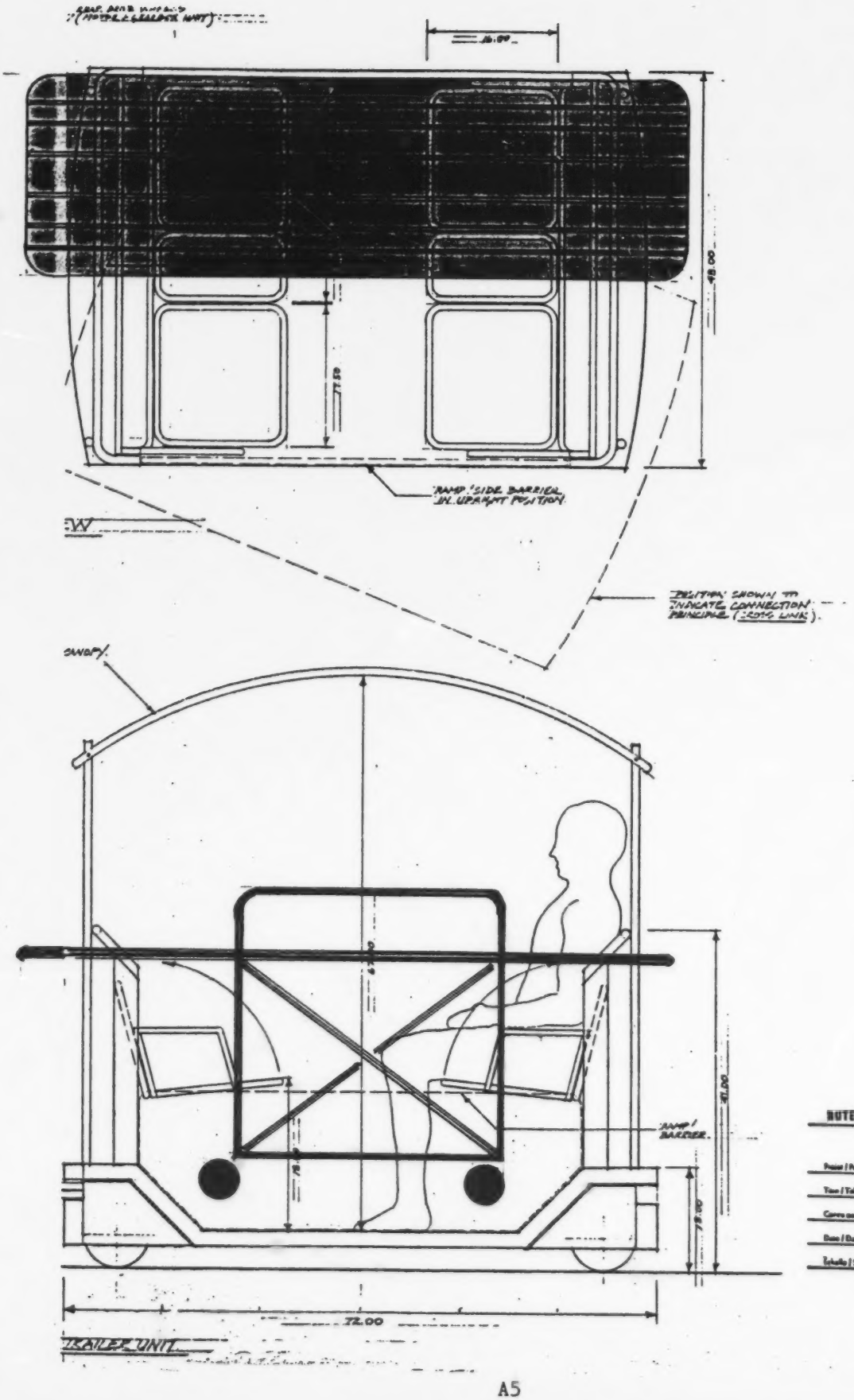
4


TOP VIEW
SECTION AA
SECTION - PART SECTION I
FRONT VIEW - SECTION BB



RUTENBERG DESIGN INC.

480, boul. Smithmore, Dorval, Qué. H9S 2J6
Tel.: (514) 636-4089

Projet / Project — SCAT - OUTDOOR MODEL

Titre / Title — PRELIMINARY LAYOUT

Dessiné par / Designed by U. RUTENBERG, M. BARBER

Date / Date — 6 DEC. 1984 .. N°: 1784/2

Échelle / Scale — 1/8" = 1.00"

2

APPENDIX B TECHNICAL DESCRIPTION

Electrical System

Three 12V batteries, deep cycle

Or six 6V batteries, deep cycle

Drive System

Traction Motor - Direct Drive

36V DC Series Wound, 2 HP at 2800 RPM

Drive/Transmission

Double reduction Helical Gear

12.12:1 Direct Drive Motor Axle

Steering

Direct tiller through rod linkage and end bearings

Brake System

Single disc, mechanical cable on pedal

Body

Open platform with metal mesh skirt and fabric canopy

Frame

Rectangular Steel Tubing 1" x 2", gauge 16

Tires

2.80/2.50 - 4; tubeless - 4 ply

13 x 5.00 - 6; tubeless - 4 ply, rating 40 Psi

Seats

Motor unit: one front seat adjacent to driver's seat

two front facing, individual passenger seats with armrests

Trailer: two front facing, individual seats with one armrest each

two backing, individual seats with one armrest each

Charging

Heavy duty charger 11 Amp for 36B

Recharge time: approx. 6 hrs at 75%

One charger on 15 amp circuit 110V

TECHNICAL DESCRIPTION

Dimensions

Overall length:	72" (1.83 m)
Overall width:	48" (1.22 m)
Overall height (with canopy):	73" (1.85 m)
Overall height (without canopy):	41" (1.04 m)
Wheelbase motorized:	56" (1.42 m)
Wheelbase trailer:	59" (1.50 m)
Ground clearance:	2" (50 mm)
Platform height:	6.5" (16.5 cm)
Weight-motor unit:	approx. 700 lbs. (330 kg)
Weight-trailer:	approx. 350 lbs. (160 kg)

Performance

Maximum speed forward unloaded: approx. 12 mph (19 km/h)

Maximum speed forward loaded: approx. 6 mph (9.5 km/h)

Turning circle: approx. 25' (8.3 m)

Braking distance: approx. 20 feet at 12 mph unloaded
(6.5 m at 19 km/h)

Seat capacity: motor unit - one driver, 3 adults

trailer - four adults

On motor unit, one wheelchair takes place of one adult

On trailer, one wheelchair takes place of one adult and child can use seat opposite

One stretcher per unit

Incline: 10%, loaded